Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE – SEMESTER V • EXAMINATION – WINTER - 2012

Subject code: 150503 Date: 17-01-2013

Subject Name: Chemical Engineering Thermodynamics - II

Time: 02:30 pm to 05:00 pm Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Derive the equation for the criteria for phase equilibrium in terms of fugacity for a mixture of N components and π phases. **07**

(b) Explain the analytical and graphical method to determine partial molar properties of components in mixtures. **07**

Q.2 **(a)** For a binary system , if the activity coefficient of component is given by moυ_1!>!bx_3^3−!find the expression for the component 2.! **07**

(b) A gas obeys the equation P (V-b) = RT For this gas b = 0.0391dm^3/mol. Calculate the fugacity and fugacity coefficient of the gas at 1000 ^{o}C and 1000 atm. **07**

OR

(b) Write in brief a note on feasibility of chemical reaction. **07**

Q.3 Assuming the validity of Raoult's law, do the following calculations for the for the system of acetone (1), acetonitrile (2) and nitromethane (3), **14**

(a) Given x_1 = 0.30 and x_2= 0.40, T = 75°C, find y_1 and P.

(b) Given y_1 = 0.45 and y_2 = 0.35, T = 80°C, find x_1 and P.

$\ln P^{sat}$ = A –[B ÷(t +C)] where P^{sat} is in kPa and t is in °C

Component	A	B	C
Acetone(1)	14.3916	2795.82	230.0
Acetonitrile (2)	14.2724	2945.47	224.0
Nitromethane (3)	14.2043	2972.64	209.0

OR

Q.3 **(a)** Write a brief note on retrograde condensation and its application. **07**

(b) Explain the methodology to be adopted for calculating the bubble point calculation for the mixtures of hydrocarbons at high pressure. **07**

Q.4 **(a)** Write a brief note on ideal solutions and non-ideal solutions. **07**

(b) Write a brief note on thermodynamic consistency test of VLE data. **07**

OR

Q.4 **(a)** Derive from first principle ΔG^o = - RTlnK. **07**

(b) Calculate the equilibrium constant Kp at 25°C for the water gas shift reaction **07**

!DP)h*!!+!!I3P)h*!!--> DP3)h*!,!I3)h*!!

Given that the standard free energies of formation at 298 K are (-32.8) kcal/mol for carbon monoxide, (-54.64) kcal /mol for steam and (-94.26) kcal/mol for carbon dioxide.

Q.5	**(a)**	Explain T-x,y diagram for partially miscible system.	**07**
	(b)	Explain the effect of inert and presence of product in initial mixture of reacting system	**07**

OR

Q.5	**(a)**	Write short note on Van Laar equation and Margules equation/	**07**
	(b)	Write in brief on phase rule for the reacting system.	**07**

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